

High mammalian diversity on the Las Piedras River tributary of Madre de Dios, Peru: an annotated list of species including comments on biogeography and regional conservation

Carter J. Payne¹, Patrick S. Champagne², Holly O'Donnell^{3,4}, Liselot R. Lange⁵, Corrie Rushford⁶, Paul Rosolie⁶, David Rosenzweig⁷

¹ Alliance for Research and Conservation in the Amazon, Puerto Maldonado, Peru

² Department of Biology, Acadia University, Wolfville, NS, Canada

³ Fauna Forever, San Sebastian, Cusco, Peru

⁴ Wildlife Conservation Research Unit (WildCRU), Department of Biology, University of Oxford Recanati-Kaplan Centre, Tubney, Oxfordshire, UK

⁵ MAQUISAPA EIRL, Puerto Maldonado, Peru

⁶ Junglekeepers Peru, Puerto Maldonado, Peru

⁷ Stanford University, Stanford, CA, USA

Corresponding author: Patrick S. Champagne (patrickchampagne@gmail.com)

Abstract. Several mammal inventories have been reported from the lowland Amazon of Madre de Dios, Peru, but few have been reported for the Las Piedras River. Here we present a list of mammal species from the Las Piedras River. Over a period of seven years (2013–2020), we recorded the presence of mammal species, excluding bats and small rodents, using camera traps and opportunistic sightings. Our study area was near the Huascar-Las Piedras River confluence, 58 km north of the Madre de Dios River and covering an area of 22,430 ha. We recorded 60 species belonging to seven orders, 26 families, and 53 genera, including novel records for the Las Piedras tributary. Notable records reported include *Leopardus* cf. *tigrinus* (Schreber, 1775), *Galictis vittata* (Schreber, 1776), *Saguinus imperator subgriseus* (Lönnerberg, 1940), *Cebuella niveiventris* (Lönnerberg, 1940), *Cyclopes thomasi* (Linnaeus, 1758), *Coendou ichillus* Voss & da Silva, 2001, and *Caluromys lanatus* (Olfers, 1818).

Key words. Biodiversity, Bush-Tailed Opossum, Dwarf Porcupine, Northern Tiger Cat, Silky Anteater, Primates, Tropical Conservation

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INTRODUCTION

The department of Madre de Dios in the Amazon rainforest of southeastern Peru is one of the most biodiverse regions in the world, and over 200 mammal species inhabit the area (Paterson and Stotz 2006). Among the notable species are large and charismatic predators like Jaguar [*Panthera onca* (Linnaeus, 1758)] (Tobler et al. 2013) and Puma [*Puma concolor* (Linnaeus, 1771)] (Salvador et al. 2011), as well as species of conservation focus such as Giant Otter [*Pteronura brasiliensis* (Gmelin, 1788)], which thrives in the region's waterways (Carcelén 2019). Although the region's diversity attracts researchers, some elusive mammals such as Short-eared Dog [*Atelocynus microtis* (Sclater, 1883)] and Bush Dog [*Speothos venaticus* (Lund, 1842)] remain poorly understood and rarely observed (Leite-Pitman and Williams 2011; Oliveira et al. 2018).

Mammal species and communities in the department face threats from human activities in the form of habitat destruction and hunting. Agriculture, artisanal gold mining, and pasture field development drive forest loss in the region, where changes in the ecological dynamics and community structures of mammals are observed (Naughton-Treves et al. 2003; Rosin and Swamy 2013; Nicolae et al. 2019). Several studies have highlighted the impact of illegal gold mining in the region on the department's biodiversity (Alvarez-Berríos et al. 2016; Asner and Tupayachi 2017; Markham and Sangermano 2018; Carcelén 2019). Mining activities have destroyed large areas of forest, the natural habitat of many mammal species, and continue to pose a risk to vulnerable areas that lack adequate enforcement (Asner and Tupayachi 2017; Markham and Sangermano 2018). Research on the pressure of hunting on mammal communities of Madre de Dios indicates



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that hunting is likely to have negative impacts on the population dynamics of hunted species, as well as on ecosystem functioning and the provisioning of ecosystem services in the region (Nunez-Iturri et al. 2008; Rosin 2012; Rosin and Swamy 2013; Bagchi et al. 2018).

Ecosystems and wildlife in Madre de Dios are provided with several levels of management. National parks and reserves protect a large portion of Madre de Dios. Tambopata National Reserve and Bahua-ja-Sonene National Park are two large, protected areas in the region, covering more than 1.3 million ha, which is approximately 16% of the total area of Madre de Dios (SERNANP 2009, 2019). Forests further benefit from several community reserves in the region (e.g. Amarakaeri Communal Reserve). Community reserves are an important part of the conservation efforts in Madre de Dios (Galvin and Thorndahl 2005). These reserves are managed by local communities and are designed to protect both the environment and the rights of the indigenous people who live in the area (Galvin and Thorndahl 2005).

Various management strategies such as national parks and reserves, community reserves, and concessions have had mixed impacts on the conservation of forests and mammal diversity. National reserves, such as the Tambopata National Reserve, have been shown to be somewhat effective in preserving forests with high mammalian diversity, but significant deforestation still occurs due to illegal gold mining and agricultural expansion (Vuohelainen et al. 2012; Asner and Tupayachi 2017). Other national parks in the area, such as Manú National Park have been shown to be effective in protecting threatened mammal species such as Giant Otter (*Pteronura brasiliensis*) (Groenendijk et al. 2014). Research on management practices of privately protected concessions, such as the Los Amigos Conservation Concession, found that although management regimes did not have much of an effect at the mammalian community level, they did have significant impacts at the local level (Mena et al. 2021). Furthermore, the introduction of sustainably managed concessions, such as Brazil-nut and conservation concessions in the Peruvian Amazon, can help maintain mammal populations by reducing pressures caused by illegal hunting (Naughton-Treves et al. 2003; Tobler et al. 2018).

The Las Piedras tributary has had little ecological investigation compared to adjacent protected areas in southeastern Peru, such as Manú National Park, Tambopata National Reserve (e.g. Patterson et al. 2006; Catenazzi et al. 2013), and other regional research areas, such as the Cocha Cashu Biological Station in Manú National Park (Groenendijk et al. 2019). In recent years the Las Piedras River has seen an increase in conservation and ecotourism activities. At least 20,000 ha of land have become conserved by sustainable practices and land management such as ecotourism and Brazil-nut harvesting (e.g. Amazon Rainforest Conservancy (<https://amazonrainforestconservancy.com/>), Alliance for Research and Conservation in the Amazon (<https://conservetheamazon.org/>), Hoja Nueva (<https://hojanueva.org/>), and Junglekeepers (<https://www.junglekeepers.com/>). These projects are contributing to the scientific literature on the ecology of the Las Piedras tributary through observational notes (e.g. O'Donnell 2020), research initiatives (e.g. Lange and Robson 2019), and academic projects (e.g. Champagne 2022).

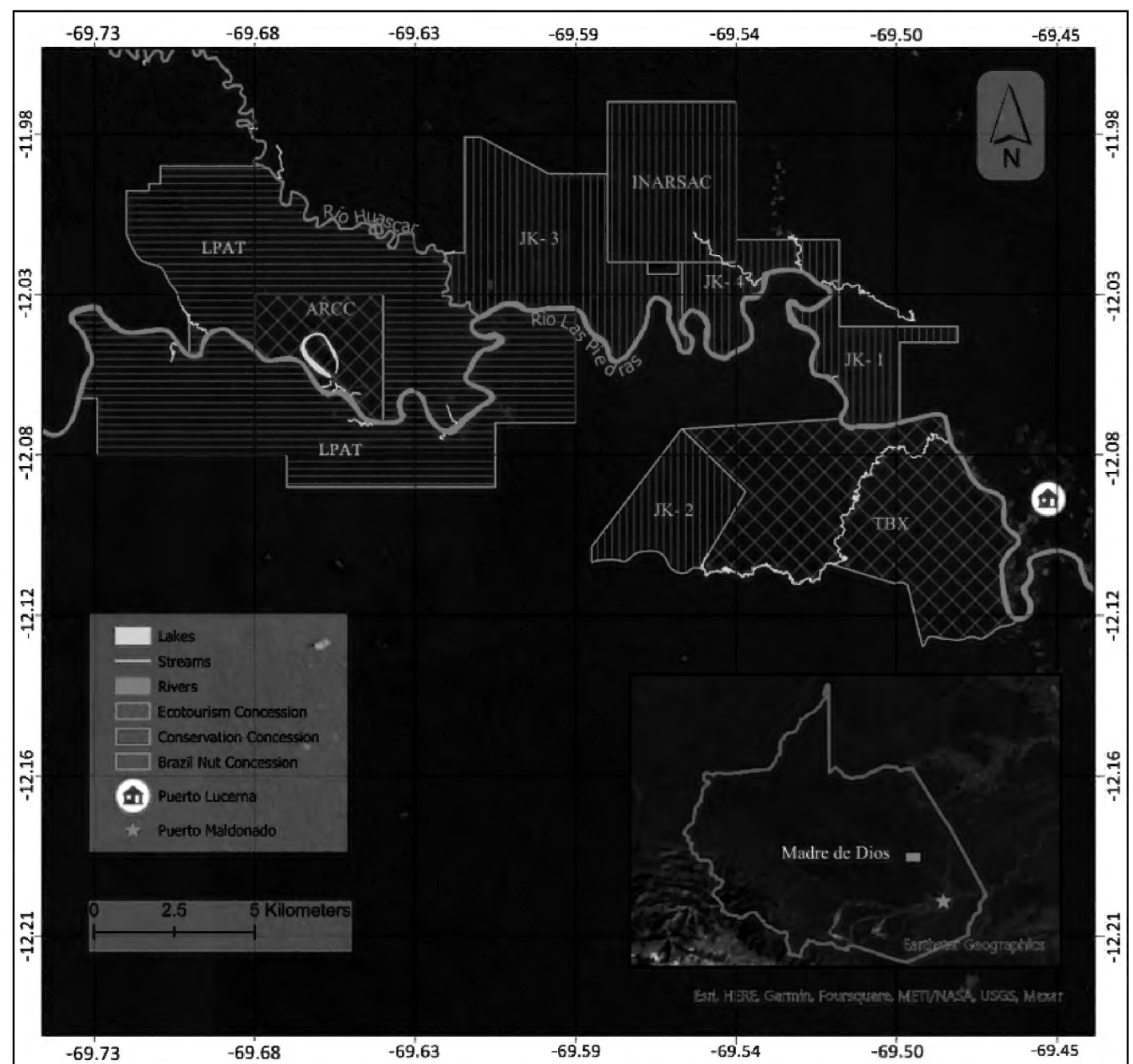
Biogeographic records play a crucial role in advancing our understanding of the natural world, supporting conservation efforts, informing decision-making processes related to the environment and species management, and species distribution modeling (Richardson and Whittaker 2010). Detailed distribution maps for many mammal species are lacking, especially for elusive or rare species, and understanding their habitat preferences and range can be useful for conservation planning (Holbrook et al. 2017; Bridle Hoffmann 2022). Faunal surveys describing the species composition on the Las Piedras River are reported for several taxa, including fish (Carvalho 2012) and herpetofauna (von May et al. 2009). Local research sites situated in primary forests with historic mammal monitoring include the Las Piedras Biodiversity Station and the Amazon Rainforest and Conservation Center. Several media platforms, expedition reports, and academic sources have highlighted the local biodiversity (e.g. the short film “Unseen World”, Zwicker 2015). A camera trap survey in 2015, part of which covered our study area, reported an inventory of 23 species of terrestrial medium-sized and large mammals over 4,066 camera trap nights (Zwicker 2015). However, an extensive review of the mammal occurrences on the tributary has not been reported, and preliminary research suggests it is an area of conservation concern because of its vulnerability to road degradation, farming, and illegal logging (Scullion et al. 2014).

Given the scarcity of available literature and biogeographic data pertaining to the Las Piedras tributary, our study aims to address this knowledge gap. Specifically, our objective is to conduct a comprehensive review of historical photographic and observational records of mammal species. By doing so, we intend to compile an inventory of all medium- and large-bodied mammal species inhabiting the area. This endeavor will not only contribute to filling the existing data void but will also complement the current local biogeographic records available for other taxa.

STUDY AREA

The study area is situated along the central area of the Las Piedras River in the Madre de Dios region of southeastern Peru. The Las Piedras River, referred to locally as Tacuatimanu, is one of the longest rivers in Peru, with a length of 640 km. It is also the longest tributary of the Madre de Dios River. Our study area consists of nine contiguous concessions (Fig. 1) located around and south of the Huascar-Las Piedras River

Figure 1. Conservation, ecotourism, and Brazil-nut concessions were sampled for mammals between 2013 and 2020 near the Huascar River and Las Piedras River confluences in the Madre de Dios department, Peru. Departmental and country boundaries sourced from the Environmental systems research institute's (ESRI) online and living atlas platforms. Imagery sources were facilitated through ESRI's image services layers, and specific sources are provided within the individual map insets. Stream tracks were generated from the field using Garmin 64s. Maps were produced using ArcGIS Pro (ESRI). ARCC = Amazon Research and Conservation Center, INARSAC = Lush Investments, JK = Junglekeepers, LPAT = Las Piedras Amazon Tours, TBX = Tambopata Expeditions.



confluence (−12.0365, −069.6253), 58 km north of the confluence of the Las Piedras and the Madre de Dios rivers. In Peru, concessions are areas of land that are leased from the local government to organizations, individuals, companies, or communities for a maximum of 40 years at a time, with the possibility of renewal (Government of Peru 2001a). Holders of concessions are required by the local federal government to manage the areas, as well as create a management plan and provide yearly reports. Conservation concessions are for the purposes of protecting biodiversity and can be used for research, education, the sustainable management of natural resources, and ecotourism. Ecotourism concessions are used sustainably for tourism, and education, research, and the extraction of non-timber forest products are also permitted. The primary difference between conservation concessions and ecotourism concessions is conservation concessions are not supposed to generate revenue and are not required to pay a yearly fee to the federal government, while ecotourism concessions are intended to generate revenue and the concession holders must pay a fee for each tourist (Government of Peru 2001b, 2002; Vuohelainen et al. 2012). Brazil-nut concessions are for the purpose of harvesting Brazil nuts, which are the fruits of the tree *Bertholletia excelsa* Humb. & Bonpl.

Five concessions in our study area are allocated for harvesting Brazil nuts: Junglekeepers (JK1, JK2, JK3, JK4) and Inversiones Agroforestales Regenerativas Perú SAC (INARSAC). Another conservation concession is owned and operated by Las Piedras Amazon Tours (LPAT). The Amazon Research and Conservation Center and Tambopata Expeditions SAC (TBX) are ecotourism concessions that operate research initiatives and tourism activities. Seven of the eight concessions directly border the Las Piedras River, four on the north and three on the south. The eighth concession is 7 km inland and west of TBX (JK2). The total area of these concessions is approximately 22,430 ha and includes a 65 km long stretch of the Las Piedras River and a 15 km stretch of the Huascar River.

The study area's habitat is consistent with the typical characteristics of the lowland Amazon rainforest in the Madre de Dios region of Peru (Bennett et al. 2023). Most of the concessions contain high-terrace terra firme forests, dominated by Brazil-nut trees and lowland floodplain forests. Small tributaries deriving from larger and steeper terra firme ridges divide the floodplain from the high-ground forests. Three large stream systems: Loboyoc (−12.071, −069.490), Loreto (−12.02, −069.52), and Loretillo (−12.02, −069.52); these streams meander through both floodplain and terra firme forests of several concessions. Small oxbow lakes from these streams create seasonally filled *Mauritia*-dominated palm swamps and black-water systems. In lower terrain, riverine successional forests exist along the rivers with extensive areas dominated by successional forests of bamboo. Several lake systems with lacustrine vegetation are present in the study area,

most notably “Lago Soledad” (−12.0501, −069.6718), an oxbow lake near the confluence of the Las Piedras and the Huascar rivers. Between the Huascar and Las Piedras rivers is a prominent ridgeline dividing the watersheds of these two rivers. Some areas have been selectively logged in the past, mainly those sharing borders with the Las Piedras River and nearby smaller tributary confluences. Historic hunting has also occurred near the port of Lucerna (Schulte-Herbrüggen and Rossiter 2003). Annual rainfall and temperature from the airport weather station in Puerto Maldonado indicate that the average annual temperature and precipitation are 29–32 °C and 56.8–342.6 mm, respectively (<https://www.weather-atlas.com>). The nearest protected areas are the Tambopata National Reserve approximately 100 km to the south, the Madre de Dios Territorial Reserve approximately 100 km to the west (upriver from our study area), and Manú National Park (MNP), which is located approximately 75 km to the west of the Madre de Dios Territorial Reserve. A private concession on the Los Amigos River, the Los Amigos Conservation Concession (LACC), lies approximately 85 km southwest of our study area.

METHODS

Records of the presence of medium- and large-bodied mammal species were collected from 2013 to 2020. Most species were recorded using camera traps, some of which were deployed in a grid, whilst in other instances cameras were deployed opportunistically along trails, along streams, or in emergent trees. Mammal species opportunistically documented by researchers and naturalists at the study site were also included. We classified each species record based on the mode of detection: terrestrial camera trap (TCT), arboreal camera trap (ACT); opportunistic observation (OP). Species were identified using standard species descriptions and photo plates as presented by Emmons and Feer (1997), Wilson and Mittermeier (2009), Mittermeier et al. (2013), and Leite-Pitman, Beck and Velazco (2003). Additional literature used for species identification is cited in Results.

Records of species captured using camera traps were identified by carefully comparing the collected images and footage with existing reference materials and expert knowledge. The grid project camera traps were deployed in a 1 km grid in July 2017, with 30 camera traps deployed in 30 locations for varying periods of activity, with 24 ultimately retrieved in October 2017, recording for a total of 457 days. Part of the methodology for the grid project mandated that cameras capture areas facing game trails. Another camera trapping project was focused on maximizing species occurrence records, and cameras were selectively placed at locations with presumed or known higher occurrence, including mineral licks, trail intersections, game trails, and crossing points for streams. The project deployed 24 paired cameras in 12 locations from January 2019 to April 2019 for a total of 90 days, followed by 22 paired cameras in 11 locations from May 2019 to September 2019 for a total of 111 days. Arboreal cameras were placed and secured in the canopy using standard tree-climbing equipment. Each camera was deployed near the crown of the trees and secured using straps. The cameras were affixed to the trees using L-shaped wooden posts, which were firmly secured to the tree with elastic straps. Four camera traps were strategically positioned in emergent trees, which are trees exceeding the height of the surrounding canopy, on the TBX concession and near the Las Piedras River. Emergent trees were selected based on several practical considerations, including accessibility factors such as the avoidance of traversing large streams with equipment, the absence of visible wasp nests in proximity, and the suitability of branch distribution for climbing gear placement. Additionally, care was taken in choosing trees with branches that could safely accommodate climbing equipment. To access the canopy and securely position the camera traps, we utilized specialized tree-climbing equipment. Throughout the study, these camera installations were periodically checked at approximately monthly intervals. Cameras were installed during the dry season, spanning from April 2017 to November 2017, encompassing a total of 442 days and nights.

Opportunistic observations include species confidently detected and identified by other means during other faunal sampling projects, and concession ranger patrols. In the study area, various research projects employed primate follow detection methods to observe Spider Monkeys (*Ateles chamek*) (Humboldt, 1812) (e.g. Lange and Robson 2019), conducted on-foot surveys of streams and rivers during both day and night to study Caiman (*Paleosuchus trigonatus*) (Schneider, 1801) (e.g. Champagne 2015), and investigated Green Anacondas (*Eunectes murinus*) (Linnaeus, 1758) in streams, flooded forests, and lake systems (e.g. Champagne 2022), which led to additional mammal observations. Similarly, some species occurrences were acquired during concession ranger patrols. Groups of two or three rangers systematically walked trail systems on the concessions of Las Piedras, and their primary objectives were to record anthropogenic disturbances and record target species, such as game animals. During patrols, rangers recorded the species they encountered, how they detected them (e.g. vocalization or visual), habitat information, behavioural data, and location data. If possible, rangers acquired photographs.

Coordinate positions of camera-trap locations and opportunistic observations were recorded using handheld Garmin GPS units (models: 00868-01, 01199-20). All maps were produced using ArcGIS Pro (Environmental Systems Research Institute (Esri), Redlands, California) and images were acquired using Esri imagery services (Figure 1).

Records depicted here were chosen based on the most precise identification and representation of the taxa. All of the source projects were independent of each other, were limited in their temporal and spatial overlap, and employed different methodologies; therefore, we avoid speculating or drawing conclusions by comparing the studies.

RESULTS

Sixty species belonging to seven orders, 26 families and 53 genera were documented (Table 1, Figures 1–12) between 2013 and 2020. Of the reported taxa, 43% ($n = 26$) were confirmed with terrestrial camera traps, 23% ($n = 14$) with arboreal camera traps, and 90% ($n = 56$) during opportunistic observations. Figures 2–12 depict species that were confirmed using camera traps or which we were able to photograph when encountered. Each of the three categories of detection included exclusive species (Table 2). Sixteen species, representing 27% of the total species documented, are considered at risk of extinction by the IUCN (2022) and are listed as either Near Threatened, Vulnerable, or Endangered. Five species (8%) are listed Data Deficient (IUCN 2022, Table 1). Twenty-seven species (45%) have protection under CITES designations (CITES I = 11, CITES II = 16; Table 1).

Table 1. Mammals of the central Las Piedras River tributary, Madre de Dios, Peru. Methods used in the research include act = arboreal camera trap; tct = terrestrial camera trap; op = opportunistic records. Lists of conservation status: DD = Data Deficient; EN = Endangered; LC = Least Concern; NT = Near Threatened; VU = Vulnerable; I = First Appendix CITES; II = Second Appendix CITES.

Order	Family	Species	Latitude	Longitude	IUCN	CITES	Detection method
Carnivora (16)	Candidae (2)	<i>Atelocynus microtis</i>	−12.1207	−069.5002	NT	-	tct, op
		<i>Speothos venaticus</i>	−12.0279	−069.7113	NT	I	tct, op
	Felidae (6)	<i>Herpailurus yaguarondi</i>	−12.0786	−069.5117	LC	I	tct, op
		<i>Leopardus pardalis</i>	−12.0786	−069.5117	LC	I	tct, op
		<i>Leopardus cf. tigrinus</i>	−12.085	−069.5289	VU	I	tct
		<i>Leopardus wiedii</i>	−12.0663	−069.4929	NT	I	tct, op
		<i>Panthera onca</i>	−12.071	−069.542	NT	I	tct, op
		<i>Puma concolor</i>	−12.0839	−069.5064	LC	I	tct, op
	Mustelidae (4)	<i>Eira barbara</i>	−12.085	−069.5289	LC	-	tct, op
		<i>Galictis vittata</i>	−12.0728	−069.4922	LC	-	tct, op
		<i>Lontra longicaudis</i>	−12.0779	−069.5111	NT	I	op
		<i>Pteronura brasiliensis</i>	−12.0503	−069.6725	EN	I	op
	Procyonidae (4)	<i>Bassaricyon alleni</i>	−12.0673	−069.4947	LC	-	act, op
		<i>Nasua nasua</i>	−12.0709	−069.542	LC	-	tct, op
		<i>Potos flavus</i>	−12.0694	−069.4937	LC	-	act, op
		<i>Procyon cancrivorus</i>	−12.097	−069.5111	LC	-	tct, op
Cetartiodactyla (4)	Cervidae (2)	<i>Mazama americana</i>	−12.1236	−069.4723	DD	-	tct, op
		<i>Mazama nemorivaga</i>	−12.1207	−069.5002	VU	-	tct, op
	Tayassuidae (2)	<i>Dicotyles tajacu</i>	−12.071	−069.4932	LC	II	tct, op
		<i>Tayassu pecari</i>	−12.0636	−069.52	VU	II	tct, op
Cingulata (4)	Chlamyphoridae (2)	<i>Cabassous unicinctus</i>	−12.085	−069.5288	LC	-	tct, op
		<i>Priodontes maximus</i>	−12.092	−069.4958	VU	I	tct, op
	Dasypodidae (2)	<i>Dasypus novemcinctus</i>	−12.0786	−069.5117	LC	-	tct, op
		<i>Dasypus pastasae</i>	−12.085	−069.5288	LC	-	tct, op
Didelphimorphia (5)	Didelphidae (5)	<i>Caluromys lanatus</i>	−12.0683	−069.4919	LC	-	act
		<i>Chironectes minimus</i>	−12.0703	−069.5234	LC	-	op
		<i>Didelphis marsupialis</i>	−12.0663	−069.491	LC	-	tct, op
		<i>Glironia venusta</i>	−12.0673	−069.4947	LC	-	act
		<i>Metachirus nudicaudatus</i>	−12.0694	−069.4938	LC	-	op
Lagomorpha (1)	Leporidae (1)	<i>Sylvilagus sp. brasiliensis defilippi</i>	−12.0786	−069.5117	DD	-	tct, op

Order	Family	Species	Latitude	Longitude	IUCN	CITES	Detection method
Perissodactyla (1)	Tapiridae (1)	<i>Tapirus terrestris</i>	−12.089	−069.4932	VU	II	tct, op
Pilosa (5)	Bradypodidae (1)	<i>Bradypus variegatus</i>	−12.0667	−069.5003	LC	II	op
	Choloepodidae (1)	<i>Choloepus hoffmanni</i>	−12.0701	−069.4907	LC	-	op
	Cyclopedidae (1)	<i>Cyclopes thomasi</i>	−12.07	−069.4978	LC	-	op
	Myrmecophagidae (2)	<i>Myrmecophaga tridactyla</i>	−12.1207	−069.5002	VU	II	tct, op
		<i>Tamandua tetradactyla</i>	−12.087	−069.5251	LC	-	act, tct, op
Primates (12)	Aotidae (1)	<i>Aotus nigriceps</i>	−12.0694	−069.4938	LC	II	act, op
	Atelidae (2)	<i>Alouatta seniculus</i>	−12.0686	−069.515	LC	II	act, tct, op
		<i>Ateles chamek</i>	−12.0694	−069.4938	EN	II	act, tct, op
	Callitrichidae (4)	<i>Callimico goeldii</i>	−12.0816	−069.5134	VU	II	op
		<i>Cebuella niveiventris</i>	−12.0061	−069.5746	VU	II	op
		<i>Leontocebus weddelli</i>	−12.0664	−069.493	LC	I	act, op
		<i>Saguinus imperator subgriseus</i>	−12.0641	−069.491	LC	II	op
	Cebidae (3)	<i>Cebus unicolor</i>	−12.1207	−069.5002	VU	II	act, tct, op
		<i>Saimiri boliviensis boliviensis</i>	−12.0689	−069.5101	LC	II	act, tct, op
		<i>Sapajus apella</i>	−12.071	−069.542	LC	II	act, tct, op
	Pitheciidae (2)	<i>Pithecia irrorata</i>	−12.0348	−069.5275	DD	II	op
		<i>Plecturocebus toppini</i>	−12.0864	−069.5102	LC	II	op
Rodentia (12)	Caviidae (1)	<i>Hydrochoerus hydrochaeris</i>	−12.0684	−069.5147	LC	-	op
	Cuniculidae (1)	<i>Cuniculus paca</i>	−12.073	−069.5116	LC	-	tct, op
	Dasyproctidae (3)	<i>Dactylomys dactylinus</i>	−12.0694	−069.4938	LC	-	op
		<i>Dasyprocta variegata</i>	−12.085	−069.5289	DD	-	tct, op
		<i>Myoprocta pratti</i>	−12.0689	−069.5102	LC	-	tct, op
	Dinomyidae (1)	<i>Dinomys branickii</i>	−12.0786	−069.5117	LC	-	tct, op
	Erethizontidae (3)	<i>Coendou bicolor</i>	−12.0709	−069.542	LC	-	tct, op
		<i>Coendou ichillus</i>	−12.0683	−069.4995	DD	-	op
		<i>Coendou longicaudatus longicaudatus</i>	−12.0683	−069.4919	LC	-	act, op
	Sciuridae (3)	<i>Microsciurus flaviventer</i>	−12.0689	−069.5101	LC	-	tct
		<i>Sciurus ignitus</i>	−12.0673	−069.4947	LC	-	act, tct
		<i>Sciurus spadiceus</i>	−12.0786	−069.5117	LC	-	tct, op

Table 2. Total number of species recorded by each method and species exclusively captured by each method.

Methods	Total	Exclusive	Exclusive species
Arboreal camera trap	14	2	<i>Caluromys lanatus</i> , <i>Glironia venusta</i>
Terrestrial camera trap	38	2	<i>Leopardus</i> cf. <i>tigrinus</i> , <i>Microsciurus flaviventer</i>
Opportunistic records	53	14	<i>Pteronura brasiliensis</i> , <i>Chironectes minimus</i> , <i>Metachirus nudicaudatus</i> , <i>Bradypus variegatus</i> , <i>Choloepus hoffmanni</i> , <i>Cyclopes thomasi</i> , <i>Callimico goeldii</i> , <i>Cebuella niveiventris</i> , <i>Saguinus imperator subgriseus</i> , <i>Pithecia irrorata</i> , <i>Plecturocebus toppini</i> , <i>Hydrochoerus hydrochaeris</i> , <i>Dactylomys dactylinus</i> , <i>Coendou ichillus</i>

Species observed

Order Carnivora
Family Canidae

***Atelocynus microtis* (Cabrera, 1940), Short-eared Dog, Perro de monte**
Figure 2A

Record. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; −12.1207, −069.500; elev. 265 m;

23.VIII.2019; C.J. Payne obs., recorded using terrestrial camera trap and opportunistically.

Identification. *Atelocynus microtis* is a medium-sized, grey canid with a head and body length of 58.3–100 cm and a weight between 6.5 and 9.0 kg. Its body is grey-black, with short, thick fur. It has a large head and small, rounded ears that extend above the top of its head. Its tail is long, with thick black fur (Emmons and Feer 1997).

***Speothos venaticus* (Lund, 1842), Bush Dog, Perro Colorado, Perro de Monte**

Record. PERU – MADRE DE DIOS • Tambopata, Las Piedras River, north of the Las Piedras and Huascar River Confluence; –12.0279, –069.7113; elev. 285 m; 14.X.2013; P.S. Champagne obs., recorded using camera trap. Camera-trap record from within a large stream bed and opportunistically.

Identification. *Speothos venaticus* is a medium-sized canid with a head and body length of 61–75 cm and a weight of 5–7 kg. It often travels in groups of 2–8 individuals. It is reddish brown but with the head lighter than the body. This species can be distinguished from *A. microtis* by its shorter ears, legs, and snout (Emmons and Feer 1997; Beisiegel and Zuercher 2005).

Family Felidae

***Herpailurus yagouaroundi* (É. Geoffroy Saint-Hilare, 1803), Jaguarundi, Puma Negro**

Figure 2B

Record. PERU – MADRE DE DIOS • Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 232 m;

Figure 2. Carnivora of the Las Piedras River tributary. **A.** *Atelocynus microtis*. **B.** *Herpailurus yagouaroundi*. **C.** *Leopardus pardalis*. **D.** *Leopardus cf. tigrinus*. **E.** *Leopardus wiedii*.



14.VI.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Herpailurus yagouaroundi* is a medium-sized felid with a head and body length of 50.5–64.5 cm and a weight of 4.5–9 kg. Its body varies from grey to black and yellowish. It has a small head and small, rounded ears. Its feet are small, and its body is narrow with a long back. Its tail is long and thin (Emmons and Feer 1997). We distinguished *H. yagouaroundi* from the somewhat similar-looking *Eira barbara* (Linnaeus, 1758) by its lack of a white or yellowish spot on its throat and its slightly larger size.

***Leopardus pardalis* (Linnaeus, 1758), Ocelot, Tigrillo**

Figure 2C

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 237 m; 9.VI.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Leopardus pardalis* is a medium-sized felid with a head and body length of 71.0–87.5 cm and a weight of 8.0–14.5 kg. The colouration varies from pale yellowish grey to brown with diverse intermediate tonalities. The ventral surface is whitish, and the black blotches tend to form open rosettes in small clusters, forming longitudinal stripes on its flanks. The head and paws are proportionally large (Emmons and Feer 1997; Murray and Gardner 1997). We distinguished *L. pardalis* from *L. tigrinus* (Schreber, 1775) by its larger size, and from *L. wiedii* (Schinz, 1821) by its larger size and shorter tail.

***Leopardus cf. tigrinus* (Schreber, 1775), Northern Tiger Cat, Tigrillo**

Figure 2D

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.085, –069.5289; elev. 269 m; 3.XI.2019; C.J. Payne obs., recorded by terrestrial camera trap.

Identification. *Leopardus tigrinus* is the smallest of the spotted South American felids with a head and body length of 38–55.6 cm, a tail length of 22.5–42 cm, and a weight of 1.3–3 kg. It has a short, slender body, and a narrow muzzle. It is smaller than both *L. pardalis* and *L. wiedii*. It has relatively more prominent ears and a shorter tail than *L. wiedii* (Wilson and Mittermeier 2009). The rosettes usually have very dark-coloured rims and are lighter inside, similar to the overall back colour. However, the rosette colouration of *L. tigrinus* can be highly variable and is sometimes like the usually darker-coloured rosettes of *L. wiedii*. *Leopardus tigrinus* has backward-facing hairs on the back of its neck, distinguishing it from *L. wiedii*, which has forward-facing hairs on its nape (Nascimento and Feijó 2017).

***Leopardus wiedii* (Schinz, 1821), Margay, Huamburushu**

Figure 2E

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0663, –069.4929; elev. 237 m; 10.VIII.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Leopardus wiedii* is a small felid with a head and body length of 42.5–79.2 cm, a tail length of 30–51 cm, and a weight of 3–9 kg. It is smaller than *L. pardalis* but larger than *L. tigrinus*. It has less prominent ears and a longer tail than *L. tigrinus* (Wilson and Mittermeier 2009). It has similarly aligned rosettes to *L. pardalis*, but not quite fused, a relatively longer tail, larger eyes, and protruding snout. The neck of *L. wiedii* is heavy with black stripes, and the fur appears to slant forward. The hind legs are shorter than the tail and are spotted or banded with black (Emmons and Feer 1997).

***Panthera onca* (É. Geoffroy Saint-Hilare, 1803), Jaguar, Otorongo**

Figure 3A

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.071, –069.542; elev. 260 m; 11.VI.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Panthera onca* is a large felid with a head and body length of 116–170 cm, a tail length of 44–80 cm, and a weight of 31–149 kg. It has a large and stocky build. The fur on its upper parts is a tawny yellow with black spots and rosettes. The underparts are white with black spots. The neck is spotted, and the ears are round, white on the inside, and black behind the tips. The tail is long and is also spotted (Emmons and Feer 1997; Wilson and Mittermeier 2009). We distinguished *P. onca* from the other large felid in our study area, *P. concolor*, by its larger size and by its spots and rosettes, which *P. concolor* lacks.

***Puma concolor* (Linnaeus, 1771). Puma, Tigre colorado, Mountain Lion, Cougar**

Figure 3B

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0839, –069.5064; elev. 238 m; 7.VII.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Puma concolor* is a large felid with a head and body length of 86–155 cm, a tail length of 60–97 cm, and a weight of 34–120 kg. It has a mostly uniformly light brown or reddish coat, with paler



Figure 3. Carnivora (continued) of the Las Piedras River tributary. **A.** *Panthera onca*. **B.** *Puma concolor*. **C.** *Eira barbara*. **D.** *Galictis vittata*. **E.** *Lontra longicaudis*. **F.** *Pteronura brasiliensis*.

underparts. It has a relatively small head with round ears and a white muzzle. The tail is long and darkens towards the tip (Emmons and Feer 1997; Wilson and Mittermeier 2009).

Family Mustelidae

***Eira barbara* (Linnaeus, 1758). Tayra, Manco**

Figure 3C

Record. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.085, –069.5289; elev. 251 m; 13.IX.2019; C.J. Payne obs. Detected using terrestrial camera traps, and opportunistic observations.

Identification. *Eira barbara* is a medium-sized mustelid with a head and body length of 56–71 cm, a tail length of 37–46 cm, and a weight of 2.7–7.0 kg. It has a long body and neck, short limbs, and a long, hairy tail. The body is dark brown, except for the head and neck, which is a lighter brown, and the throat, which has a white or yellow spot. The small ears are rounded and do not extend above the top of the head. The tail has thick fur and is roughly two-thirds as long as the head and body (Emmons and Feer 1997; Wilson and Mittermeier 2009).

***Galictis vittata* (Schreber, 1776). Greater Grison, Huron**

Figure 3D

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River, Loboyoc Stream; –12.0728, –069.4922; elev. 235 m; 8.VI. 2016; H. O'Donnell obs., recorded by a terrestrial camera trap and opportunistically.

Identification. *Galictis vittata* is a medium-sized mustelid with a head and body length of 45–60 cm, a tail length of 14–20 cm, and a weight of 1.5–3.8 kg. Its upper body is a mixture of pale grey and dark brown fur, while its lower body is a black colouration near the front and a mixture of grey and dark brown near the back of the body. The top of the head is grey, while the nose and mouth are black. A band of white fur runs above the eyes, through the ears, and onto the neck. It has small, round ears. Its short tail has a mixture of grey and dark brown fur. The legs and feet are black, and the feet have partial webbing (Emmons and Feer 1997).

***Lontra longicaudis* (Olfers, 1818). Neotropical River Otter, Nutria**

Figure 3E

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; Loboyoc Stream; –12.0779, –069.5111; elev. 233 m; 22.V.2018; P.S. Champagne obs., observed opportunistically during other faunal surveys.

Identification. *Lontra longicaudis* is a medium-sized mustelid with a head and body length of 36–66 cm, a tail length of 37–84 cm, and a weight of 5–15 kg. It has dark brown or grey fur, which is lighter around the throat and snout. It has a small, flat head and a broad muzzle. Its tail is long and thick and becomes narrower towards the end (Emmons and Feer 1997). It can be distinguished from the other semiaquatic mustelid in our study area, *Pteronura brasiliensis*, by its much smaller size.

***Pteronura brasiliensis* (Gmelin, 1788), Giant Otter, Lobo de Río**

Figure 3F

Record. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; Soledad Lake; –12.0503, –069.6725; elev. 240 m; 23.VI.2019; P. Rosolie obs., recorded opportunistically.

Identification. *Pteronura brasiliensis* is a large and aquatic mustelid with a body length of 86–140 cm, a tail length of 33–100 cm, and a weight of 22–32 kg. Its fur is short and dark brown, with light patches on the chest and throat. Individuals have their patches in a unique pattern, which allows for recognition. The feet have interdigital webbing. The tail is long and dorsoventrally flattened (Emmons and Feer 1997; Noonan et al. 2017).

Family Procyonidae

***Bassaricyon alleni* (Thomas, 1880), Eastern Lowland Olingo, Chosna**

Figure 4A

Records. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0673, –069.4947; elev. 238 m; 24.VI.2017; C. Rushford obs., recorded by arboreal camera traps, line transects, and opportunistic recordings.

Identification. *Bassaricyon alleni* is a small, arboreal procyonid with a head and body length of 30–49 cm, a tail length of 35–53 cm, and a weight of 0.6–1.6 kg. It has a slender body and short legs. It is tawny brown colouration but sometimes darker along the midline. Its underparts are cream or buff. The crown of its head is dark, while its face has a grizzled grey colouration. Its tail is slightly longer than its head and body and is bushy in appearance (Emmons and Feer 1997; Wilson and Mittermeier 2009). It is smaller than the other arboreal procyonid in our study area, *Potos flavus* (Schreber, 1774). Additionally, *B. alleni* has a no prehensile tail, while *Potos flavus* has a prehensile tail.

***Nasua nasua* (Linnaeus, 1766), South American Coati, Achuni**

Figure 4B

Records. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0709, –069.542; elev. 269 m; 6.VI.2019; C.J. Payne obs., recorded by terrestrial camera traps, line transects, and opportunistic recordings.

Identification. *Nasua nasua* is a diurnal and largely arboreal procyonid with a head and body length of 43–58 cm, a tail length of 42–55 cm, and a weight of 2.0–7.2 kg. It has a triangular head with pale spots above, below, and behind its eyes. Its ears are small, round and fringed with white. Its snout is long and pointed, and its throat and chin are grizzled white. Its body colouration varies from orange to light or dark brown. It has a long, black-striped tail, which is sometimes held vertically (Emmons and Feer 1997; Wilson and Mittermeier 2009). We distinguished *N. nasua* from the somewhat similar *Procyon cancrivorus* (Cuvier, 1798) by its longer, narrower tail and a longer snout.

***Potos flavus* (Schreber, 1774), Kinkajou, Chosna**



Figure 4. Carnivora (continued) of the Las Piedras River tributary. **A.** *Bassaricyon alleni*. **B.** *Nasua nasua*. **C.** *Potos flavus*. **D.** *Procyon cancrivorus*.

Figure 4C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0694, –069.4937; elev. 237 m; 25.VIII.2017; C. Rushford obs., recorded using arboreal camera traps and opportunistic observation.

Identification. *Potos flavus* is a medium-sized arboreal procyonid with a head and body length of 46–76 cm, a tail length of 39–57 cm, and a weight of 1.4–4.5 kg. It has a reddish-brown to grey-brown body with a dark stripe on the mid-back. It has a round head, short muzzle, pointed nose, and large, round eyes. The head is red-brown to black, and the eyes are brown. It can be distinguished from *B. alleni* by its prehensile tail. Its tail is tapered towards the end and is slightly longer than its head and body. The base of its tail is brown and typically darkens to black at the tip (Emmons and Feer 1997; Wilson and Mittermeier 2009).

***Procyon cancrivorus* (G. Cuvier, 1798), Crab-eating Raccoon, Mapache**

Figure 4D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.097, –069.511; elev. 263 m; 27.VII.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Procyon cancrivorus* is a nocturnal, mostly terrestrial procyonid with a head and body length of 54–76 cm, a tail length of 25–38 cm, and a weight of 3.1–7.7 kg. It has coarse, short hair varying from dark brown to grey. This species has a black mask that extends from the eyes to the base of the mandible, and there is a ringed tail (Emmons and Feer 1997; Wilson and Mittermeier 2009). We distinguished *P. cancrivorus* from *N. nasua* by its shorter snout, and shorter, bushier tail.

Order Cetartiodactyla
Family Cervidae

***Mazama americana* (Erxleben, 1777), Red Brocket Deer, Venado Colorado**

Figure 5A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.1236, –069.4723; elev. 231 m; 28.I.2019; C.J. Payne obs., recorded by a terrestrial camera trap and opportunistic sightings.

Identification. *Mazama americana* is a small cervid with a body length of 105–144 cm and a weight of 24–48 kg. It is light to dark reddish-brown, with a brown neck and white blotches at the base of its ears. It



Figure 5. Cetartiodactyla of the Las Piedras River tributary. **A.** *Mazama americana*. **B.** *Mazama nemorivaga*. **C.** *Dicotyles tajacu*. **D.** *Tayasu pecari*.

is larger than *Mazama nemorivaga* (F. Cuvier, 1817), with a more reddish coat (Emmons and Feer 1997; Rossi 2000).

***Mazama nemorivaga* (F. Cuvier, 1817) Amazonian Brown Brocket Deer, Gray Brocket Deer, Venado cenizo**

Figure 5B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.1207, –069.5002; elev. 265 m; 26.V.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistic sightings.

Identification. *Mazama nemorivaga* is a small cervid with a head and body length of 87–135 cm and a weight of 11–18 kg. It is greyish brown, with light-grey to white front of its neck. It is smaller and thinner than *M. americana*, and its coat is greyer (Emmons and Feer 1997).

Family Tayassuidae

***Dicotyles tajacu* (Linnaeus, 1758), Collared Peccary, Sajino**

Figure 5C

Record. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.071, –069.4932; elev. 238 m; 12.II.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistic observations.

Identification. *Dicotyles tajacu* is a pig-like ungulate with a head and body length of 80–98 cm and a weight of 17–35 kg. Its head and body are greyish brown, with a distinctive white collar around its neck. Its head is large and sharply reduces in thickness towards the snout. Its nose is disc-shaped and mostly hairless, and its tail is very short and usually not visible (Emmons and Feer 1997). We distinguished *D. tajacu* from *Tayassu pecari* (Link, 1795) by its smaller size and distinctive white collar, which *T. pecari* lacks.

***Tayassu pecari* (Link, 1795), White-lipped Peccary, Huangana**

Figure 5D

Record. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0636, –069.52; elev. 239 m; 30.VIII.2018; P. Rosolie obs., recorded by terrestrial camera trap, mammal surveys, and opportunistic observation.

Identification. *Tayassu pecari* is a pig-like ungulate with a head and body length of 95–110 cm and a

weight of 25–45 kg. Its fur is dark brown to black, with distinctive white bands along the jawline and on the snout (Mayers and Wetzel 1987; Emmons and Feer 1997). We distinguished *T. pecari* from *D. tajacu* by its larger size and the white bands on its jawline, which *D. tajacu* lacks.

Order Cingulata
Family Chlamyphoridae

***Cabassous unicinctus* (Linnaeus, 1758), Southern Naked Tailed Armadillo, Carachupa enano**

Figure 6A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.085, –069.5288; elev. 260 m; 21.X.2017; D. Rosenzweig obs., recorded by terrestrial camera traps.

Identification. *Cabassous unicinctus* is a small armadillo with a head and body length of 34–44 cm and a weight of 2.5–3.6 kg. Its bony shell is dark grey, with the lower edge of the shell yellowish. The shell has 10–13 bands that are somewhat subtle and difficult to distinguish. The scales are small and squarish. The ears are large and widely spaced on the top of the head. The long, thin tail is primarily devoid of scales, and the tip is pale. All four feet contain five claws, and the central claws on the forefeet are disproportionately large (Emmons and Feer 1997).

***Priodontes maximus* (Kerr, 1792), Giant Armadillo, Carachupa gigante**

Figure 6B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.092, –069.4958; elev. 238 m; 4.II.2019; C.J. Payne obs., recorded by terrestrial camera traps, line transects, and opportunistically.

Identification. *Priodontes maximus* is a large armadillo species with a head and body length of 75–100 cm, a tail length of 50 cm, and a weight of 18–32 kg. The body is dark brown, with a yellow stripe around the edges of the body. The carapace is highly flexible, with 11–13 moveable bands, but it does not cover the lower sides or legs. The underparts are pinkish and are sparsely covered in hair (Emmons and Feer 1997; Carter et al. 2016). The head has a conical snout and small wide-set ears (Emmons and Feer 1997). The tail is long, narrow, and covered with small pentagonal scales (Carter et al. 2016).

Family Dasypodidae

Figure 6. Cingulata of the Las Piedras River tributary. **A.** *Cabassous unicinctus*. **B.** *Priodontes maximus*. **C.** *Dasypus pastasae*. **D.** *Dasypus novemcinctus*.



***Dasypus novemcinctus* (Linnaeus, 1758), Nine-banded Armadillo, Carachupa**

Figure 6C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 239m; 6.VII.2019; C.J. Payne obs., recorded by terrestrial camera traps, line transects, and opportunistic sightings.

Identification. *Dasypus novemcinctus* is a medium-sized armadillo with a body length of 35–57 cm, a tail length of 26–53 cm, and a weight of 2–6 kg. It has a carapace that covers the body and there are eight or more movable bands (Gardner 2008). The tail is long and has scales in circular, ring-like patterns. These scales are triangular along the dorsal bands but transition into being more rounded over the rest of the body. The upper body is grey, but the flanks are yellowish. The underparts are pinkish yellow. The ears are large and close together. The muzzle is long and thin. The hindfeet contain five claws, while the forefeet have four claws (Emmons and Feer 1997). We distinguished *D. novemcinctus* from the somewhat similar *Dasypus pastasae* (Thomas, 1901) by its smaller size and greater number of movable bands.

***Dasypus pastasae* (Thomas, 1901), Greater Long-nosed Armadillo, Carachupa**

Figure 6D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.085, –069.5288; elev. 262 m; 6.VII.2019; C.J. Payne obs., recorded by terrestrial camera traps, line transects, and opportunistic sightings.

Identification. *Dasypus pastasae* is a large armadillo species with a head and body length of 51–57 cm, a tail length of 32–48 cm, and a weight of 8.5–10.5 kg. Its scales form 7 or 8 movable bands, with large, protruding scales on its hind legs (Eisenberg and Redford 1999). It was distinguished from *D. novemcinctus* by its larger size and fewer mobile bands. *D. pastasae* was previously known as *Dasypus kappleri* before undergoing taxonomic revision by Feijó and Cordeiro-Estrela (2016). The Madre de Dios River appears to form a geographic barrier between *D. pastasae* and *Dasypus beniensis* (), which is also in the *D. kappleri* species complex (Feijó and Cordeiro-Estrela 2016). We have determined that the species we observed is *D. pastasae* because our observations occurred north of the Madre de Dios River.

Order Didelphimorphia

Family Didelphidae

***Caluromys lanatus* (Olfers, 1818), Brown-eared Woolly Opossum**

Figure 7A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0683, –069.4919; elev. 240 m; 20.IX.2017; C. Rushford obs., recorded using arboreal camera traps.

Identification. *Caluromys lanatus* is a small opossum species with a head and body length of 21–30 cm, a tail length of 33–45 cm, and a weight of 31–52 g. The upper part of its fur is red-brown to pale brown, and its head is grey with a dark stripe down the centre. Its tail has fur on the proximal half, and the distal half is naked and with brown spots at the base. Females only develop a pouch when carrying young (Emmons and Feer 1997).

***Chironectes minimus* (Zimmermann, 1780), Water Opossum**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0703, –069.5234; elev. 235 m; 20.VIII.2013; P.S. Champagne obs., recorded opportunistically during herpetological stream surveys.

Identification. *Chironectes minimus* is a semi-aquatic opossum species with a head and body length of 26–30 cm, a tail length of 36–40 cm, and a weight of 590–700 g. The most identifying feature is the four large brownish-black spots across the back, joined by a narrow stripe down the spine. The fur tends to be silver-grey. The hind feet are completely webbed (Emmons and Feer 1997). Both sexes have a backward-facing pouch (Fernandez et al. 2015).

***Didelphis marsupialis* (Linnaeus, 1758), Common opossum, Intuto**

Figure 7B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0663, –069.491; elev. 233 m; 22.VI.2012; P.S. Champagne obs., recorded using arboreal camera traps, terrestrial camera traps, and opportunistically.

Identification. *Didelphis marsupialis* is a medium-sized opossum with a head and body length of 32–42 cm, a tail length of 39.5 cm, and a weight of 0.5–1.6 kg. It has large, black ears, pale fingers, and a face



Figure 7. Didelphidae of the Las Piedras River tributary. **A.** *Caluromys lanatus*. **B.** *Didelphis marsupialis*. **C.** *Glironia venusta*. Leporidae: **D.** *Sylvilagus* sp.

and tail without hair. The upper part of its body is blackish grey and the lower body has light-yellowish fur. The length of the tail usually exceeds that of the head and body combined. Females have a forward-facing pouch (Emmons and Feer 1997).

***Glironia venusta* (Oldfield Thomas, 1912), Bushy-tailed Opossum**

Figure 7C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0679, –069.4947; elev. 241 m; 23.VIII.2017; C. Rushford obs., recorded using arboreal camera traps.

Identification. *Glironia venusta* is a small opossum with a body length of 160–205 mm and a weight of approximately 140 g. *G. venusta* exhibits prominent dark brown or black and white vertical stripes on its face and a prehensile tail mostly covered in fur. Females do not have a pouch (Emmons and Feer 1997). Identification was provided by Louise H. Emmons and Luis Ruedas.

***Metachirus nudicaudatus* (É. Geoffroy, 1803), Brown Four-eyed Opossum**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0694, –069.4938; elev. 224 m; 1.V.2020; P. Rosolie obs., recorded opportunistically.

Identification. *Metachirus nudicaudatus* is a small opossum with a head and body length of 250–280 mm, a tail length of 195–390 mm, and a weight of 300–480 g. It has brownish fur and a lighter underbelly. Above the eyes and at the base of the ear, there are large, pale-yellow spots. The tail is naked from near its base and generally brown or grey. Females do not have a pouch. (Emmons and Feer 1997).

Order Lagomorpha

Family Leporidae

***Sylvilagus* sp. (Linnaeus, 1758), Conejo, Amazon Rabbit, Conejo de monte**

Figure 7D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 239 m; 25 August 2019; C.J. Payne obs., recorded by a terrestrial camera trap and opportunistically.

Identification. The *S. brasiliensis* species complex is a small forest rabbit. It has a head and body length of 268–395 mm and a weight of 450–1,200 g. It has relatively long ears, a predominantly brown body, and a black tail that is darker on top and lighter near the bottom. Its upper parts are dark and generally black or tawny, and its underparts are lighter (Emmons and Feer 1997; Diersing and Wilson 2017). Recently, the

taxonomy of *Sylvilagus* has been under review. *Sylvilagus brasiliensis* was previously listed in the Las Piedras region (Emmons and Feer 1997). Recent research by Diersing and Wilson (2017) suggests it is possible that either *S. brasiliensis defilippi* or *S. andinus* may reside in the Amazon Basin. Diersing and Wilson (2017) highlighted the importance of collecting morphological and molecular samples across the Andes and into the Amazon Basin to determine the range of *S. andinus* in the lowland Amazon. Other researchers such as Rudeas et al. (2019) believe that there is a clear species distinction between *S. andinus* and *S. brasiliensis*. Although the distribution of these two species remains unknown, Rudeas et al. (2019) stated that *S. andinus* is restricted to the Andes. Without further morphological and molecular samples, it is still not clear which species of *Sylvilagus* occur in our study area. Morphological identification of the subspecies is difficult in the genus.

Order Perissodactyla

Family Tapiridae

***Tapirus terrestris* (Linnaeus, 1758), Lowland Tapir, Sachavaca**

Figure 8A

Records. PERU – MADRE DE DIOS • Tambopata, Las Piedras River; –12.089, –069.4932; elev. 237 m; 6.VII.2019; C.J. Payne obs., recorded by terrestrial camera traps, opportunistic sightings, and camera

Figure 8. Perissodactyla and Pilosa of the Las Piedras River tributary. **A.** *Tapirus terrestris*. **B.** *Bradypus variegatus*. **C.** *Choloepus hoffmanni*. **D.** *Cyclopes thomasi*. **E.** *Myrmecophaga tridactyla*. **F.** *Tamandua tetradactyla*.



trapping.

Identification. *Tapirus terrestris* is a large ungulate with a head and body length of 170–200 cm and a weight of 227–250 kg. It has a grey body, and there is a black mane extending from the bottom of the snout to the centre of the back. The upper lip is elongated and forms a movable trunk. The tail is short and mostly hairless. Juvenile individuals are grey-brown with yellowish white horizontal stripes (Padilla and Dowler 1994; Emmons and Feer 1997).

Order Pilosa
Family Bradypodidae

***Bradypus variegatus* (Schinz, 1825), Brown-throated Sloth, Perezoso de tres dedos**

Figure 8B

Records. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0667, –069.5003; elev. 239 m; 3.VI.2019; P. Rosolie obs., recorded opportunistically.

Identification. *Bradypus variegatus* is a three-toed sloth species with a head and body length of 40–75 cm and a weight of 2.3–5.5 kg. The dorsal body is covered in long, coarse, pale brown fur. Whitish fur patches are present on the hind legs and lower back. Its head is small, with a whitish-brown face and a band of dark fur across its eyes. The throat and chest are brown. The tail is short but visible. Its forefeet and hindfeet have three claws (Emmons and Feer 1997). It is smaller and has a shorter snout than *Choloepus hoffmanni* (W. Peters, 1858), the other sloth species in the Madre de Dios region.

Family Choloepodidae

***Choloepus hoffmanni* (W. Peters, 1858), Hoffman's Two-toed Sloth, Perezoso de dos dedos**

Figure 8C

Records. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.0701, –069.4907; elev. 236 m; 12.I.2018; P.S. Champagne obs., recorded opportunistically.

Identification. *Choloepus hoffmanni* is a large sloth species with a head and body length of 52–70 cm and a weight of 4.5–8.1 kg. It has long, greenish-tan fur, and its legs are brown. It has a light-coloured face and throat and a round head with hair that extends over its ears. Its claws are long and curved, with three claws on its hindfeet and two on its forefeet. Its tail is usually not visible (Emmons and Feer 1997). It is larger and has a longer snout than *B. variegatus*, the other sloth species in the Madre de Dios region.

Family Cyclopedidae

***Cyclopes thomasi* (Linnaeus, 1758), Silky Anteater, Serafin**

Figure 8D

Records. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.07, –069.4978; elev. 238m; 10.IX.2019; P.S. Champagne obs., recorded opportunistically.

Identification. *Cyclopes thomasi* is a very small anteater species with a head and body length of 360–450 mm, a tail length of 170–240 mm, and a weight of 200–400 g. It has an orange or reddish-brown body and grey legs and tail. It lacks a dorsal stripe and has a faint ventral stripe. The presence of a ventral stripe and lack of a dorsal stripe can differentiate *C. thomasi* from other *Cyclopes* species except for *Cyclopes catellus*, which has a more prominent ventral stripe than *C. thomasi* and lacks a grey colouration on its legs and tail (Miranda et al. 2017). Species identification confirmed by Miranda (personal communication).

Family Myrmecophagidae

***Myrmecophaga tridactyla* (Linnaeus, 1758), Giant Anteater, Oso bandera**

Figure 8E

Records. PERU – **MADRE DE DIOS** · Tambopata, Las Piedras River; –12.1207, –069.5002; elev. 264 m; 2.VIII.2019; C.J. Payne obs., recorded by terrestrial camera trap, line transect and opportunistically.

Identification. *Myrmecophaga tridactyla* is the largest of the anteater species with a head and body length of 100–190 cm and a weight of 22–39 kg (Emmons and Feer 1997). The fur on its body is dense and dark grey and black (Gaudin et al. 2018). The snout is elongated, convexly curved, and grizzled grey. Its ears are small and round. The forelegs are white, with black bands on the toes and a white stripe oriented diagonally toward the body (Gaudin et al. 2018). Its forefeet have three large and two shorter claws, while its hindfeet have five short claws (Emmons and Feer 1997). The tail is large and has long, thick fur (Gaudin et al. 2018).

***Tamandua tetradactyla* (Linnaeus, 1758)**, Southern Tamandua, Oso Hormiguero
Figure 8F

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.069, –069.493; elev. 237 m; C. 23.X.2017; Rushford obs., recorded by a terrestrial camera trap, arboreal camera trap, and opportunistically.

Identification. *Tamandua tetradactyla* is a medium-sized anteater species with a head and body length of 53–88 cm and a weight 3.6–8.4 kg. It has short, pale to yellowish fur, a black vest over its lower back, and two black scapular stripes across its chest. The snout is elongated and convexly curved. The forefeet have four long claws, while the hindfeet have five smaller claws. The prehensile tail is furred at the base and naked towards the tip (Emmons and Feer 1997).

Order Primates
Family Aotidae

***Aotus nigriceps* (Dollman, 1909)**, Black-headed Night Monkey, Musmuqui
Figure 9A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0694, –069.4938; 236 m; 13.VI.2017; C. Rushford obs., recorded using arboreal camera traps and opportunistically.

Figure 9. Primates of the Las Piedras River tributary. **A.** *Aotus nigriceps*. **B.** *Alouatta seniculus*. **C.** *Ateles chamek*. **D.** *Cebuella niveiventris*. **E.** *Leontocebus weddelli*. **F.** *Saguinus imperator subgrisecens*.



Identification. *Aotus nigriceps* is a small primate with a head and body length of 350–420 mm and a weight of 875–1040 g (Mittermeier et al. 2013). It has large eyes that lay close together, with white patches over them, black lines contouring the white patches, and a triangular black extension on the forehead (Emmons and Feer 1997; Mittermeier et al. 2013). Its tail is brown or dark rusty and has a bushy black tip. The upperparts are grizzled grey to brown, and the sides of the neck, chest, and inner sides of the arms and legs are partly or entirely orangish (Emmons and Feer 1997; Mittermeier et al. 2013).

Family Atelidae

***Alouatta seniculus* (Linnaeus, 1766), Colombian Red Howler Monkey, Coto mono**

Figure 9B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0686, –069.515; elev. 234 m; 4.VIII.2017; C. Rushford obs., recorded using arboreal camera traps, terrestrial camera traps, and opportunistically.

Identification *Alouatta seniculus* is a large primate with a head and body length of 48–63 cm and a weight of 4–9 kg (Mittermeier et al. 2013). It is mainly golden-toned to coppery-red but with some body parts, like the tail, shoulders, head, and limbs, a deep maroon (Mittermeier et al. 2013). Males are generally larger than females and have a longer beard (Emmons and Feer 1997; Mittermeier et al. 2013). *Alouatta seniculus* has a prehensile tail, which is often coiled around tree branches (Emmons and Feer 1997).

***Ateles chamek* (Humboldt, 1812), Black-faced Black Spider Monkey, Maquisapa**

Figure 9C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0694, –069.4938; elev. 238 m; 5.IX.2018; P.S. Champagne obs. Terrestrial camera traps, mammal surveys, and opportunistic recordings.

Identification. *Ateles chamek* is a large primate with a head and body length of 40–60 cm and a weight of around 5–7 kg (Mittermeiers et al. 2013). It has completely black fur, except in some individuals, which have a silvery coloured genital patch and some white facial hairs (Mittermeier et al. 2013). Its facial skin is usually entirely black, but older individuals sometimes develop depigmentation around the eyes (Mittermeier et al. 2013). The limbs are long, and the prehensile tail acts as a fifth limb (Emmons and Feer 1997).

Family Callitrichidae

***Callimico goeldii* (Thomas, 1904), Goeldi’s Monkey, Pichico**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0816, –069.5134; elev. 239 m; 5.V.2016; P.S. Champagne obs., recorded opportunistically during other faunal surveys.

Identification. *Callimico goeldii* is a small primate with a head and body length of 190–250 mm and a weight of 483–500 g. It has black to blackish-brown fur and a flat nose (Mittermeier et al. 2013). Its face is sparsely haired, and the visible skin of its face, ears, hands, and feet is black (Emmons and Feer 1997; Mittermeier et al. 2013). It has hair surrounding its face creating a round shape (Mittermeier et al. 2013).

***Cebuella niveiventris* (Lönnerberg, 1940), Eastern Pygmy Marmoset**

Figure 9D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0061, –069.5746; elev. 289 m; 5.XI.2019; P. Rosolie obs., recorded opportunistically.

Identification. *Cebuella niveiventris* is a very small primate with a head and body length of 120–160 mm and a weight of 85–140 g (Emmons and Feer 1997; Mittermeier et al. 2013). Its fur is variegated with tawny buff and grey-brown, and its tail is slender, with blackish bands (Emmons and Feer 1997; Mittermeier et al. 2013). This species is distinguished from *Cebuella pygmea* () by its whitish chest, belly, and paler inner surfaces of its arms and legs (Lönnerberg 1940; Mittermeier et al. 2013; de la Torre et al. 2021).

***Leontocebus weddelli* (Deville, 1849), Weddell’s Saddle-back Tamarin, Pichico**

Figure 9E

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0664, –069.493; elev. 239 m; 5.VIII.2019; C.J. Payne obs., captured on terrestrial camera traps and opportunistically.

Identification. *Leontocebus weddelli* is a small primate with a head and body length of 180–270 mm and a weight of 340–440 g (Mittermeier et al. 2013). It is an overall black monkey with a saddle of variegated black and orange striations, an orange belly, and reddish-brown hind legs (Emmons and Feer 1997;

Mittermeier et al. 2013). The base of its tail is reddish-brown, merging into solid black for the rest of the tail (Mittermeier et al. 2013). Its head is black with brown eyes, a white band crossing the forehead, and a greyish muzzle (Emmons and Feer 1997; Mittermeier et al. 2013).

***Saguinus imperator subgriseus* (Goeldi, 1907), Bearded-emperor Tamarin, Pichico Barbados**

Figure 9F

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0641, –069.491; elev. 280 m; 7.IX.2019; P. Roslie obs., recorded opportunistically.

Identification. *Saguinus imperator subgriseus* is a small primate with a head and body length of 230–260 mm and a weight of 400–550 g (Mittermeier et al. 2013). This subspecies is distinguished from other tamarins by its white, down-curling, long moustache (Emmons and Feer 1997; Mittermeier et al. 2013). Its upper body is variegated dark grey and buffy, and the undersides and inner surfaces of its arms are rusty reddish to orangish (Mittermeier 2013). Its tail is bright rusty orange with a black tip, and the rest of its main body is grizzled pale grey but with blackish ears, hands, and feet (Emmons and Feer 1997). We distinguished *S. i. subgriseus* from Emperor Tamarin, *Saguinus imperator imperator* (), by its long, white, tufted chin whiskers, which *S. i. imperator* lacks (Hershkovitz 1979).

Family Cebidae

***Cebus unicolor* (Spix, 1823), Spix's White-fronted Capuchin, Machin blanco, Martin blanco**

Figure 10A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.1207, –069.5002; elev. 267 m; 07.IX.2017; C. Rushford obs., recorded using arboreal camera traps, terrestrial camera traps, and opportunistically.

Identification. *Cebus unicolor* is a medium-sized primate with a head and body length of 36.5–37.5 cm. No data are yet available on the specific weight of this species. *Cebus unicolor* has a creamy-fawn front and a greyish-brown dorsal area, which is greyer towards the flanks and darker towards the shoulders. Its crown is blackish, and its arms, legs, and tail are reddish yellow (Mittermeier et al. 2013). We distinguished *C. unicolor* from *Sapajus apella* (Linnaeus, 1758) by its much paler fur.

***Saimiri boliviensis boliviensis* (I. Geoffroy & de Blainville, 1834), Bolivian Squirrel Monkey, Fraile,**

Figure 10. Primates (continued) of the Las Piedras River tributary. **A.** *Cebus unicolor*. **B.** *Saimiri boliviensis ssp. boliviensis*. **C.** *Sapajus apella*. **D.** *Pithecia irrorata* (photograph by Gordon Dimmig).



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Figure 10B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0689, –069.5101; elev. 239 m; 3.IX.2019; C.J. Payne obs., recorded by an arboreal camera trap, terrestrial camera trap, and opportunistic recordings.

Identification. *Saimiri boliviensis boliviensis* is a small primate with a head and body length of 260–310 mm and a weight of 700–1,000 g. Males are usually larger than females. Males have greyish dorsal hairs, while females are darker and black. Both male and female *S. b. boliviensis* usually have a black crown and a black tip at the end of their tail. Their hands, feet, and forearms are warm yellow, and they have a distinctive white brow line above their eyes (Mittermeier et al. 2013).

***Sapajus apella* (Linnaeus, 1758), Black-capped Capuchin, Machin negro, Martin negro**

Figure 10C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.071, –069.542; elev. 258 m; 24.VIII.2017; C. Rushford obs., recorded by an arboreal camera trap, terrestrial camera trap, and opportunistically.

Identification. *Sapajus apella* is a medium-sized primate with a head and body length of 37.5–45.5 cm and a weight of 1.3–4.6 kg. Males are usually larger than females (Mittermeier et al. 2013). Its head and crown are blackish, and the hair forms short tufts above the ears (Emmons and Feer 1997). It has white temples and whitish patches above its eyes (Mittermeier et al. 2013). Its is dark chestnut-brown dorsally, turning reddish on the flanks, and its chest and shoulders are a lighter (Emmons and Feer 1997; Mittermeier et al. 2013). Its forearms, legs, and semiprehensile tail are black (Emmons and Feer 1997; Mittermeier et al. 2013).

Family Pitheciidae

***Pithecia irrorata* (Gray, 1842), Gray's Bald-faced Saki, Mono huapo**

Figure 10D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0348, –069.5275; elev. 238 m; 5.VI.2016; G. Dimmig. Recorded during mammal surveys and opportunistically.

Identification. *Pithecia irrorata* is a small to medium-sized primate with a head and body length of 36–53 cm and a weight of 2.0–2.9 kg. It has a long and bushy tail and long fur on its body. Both sexual dimorphism and dichromatism occur in *P. irrorata*. The males are slightly larger than females, and while the males have a hairless, dark-pink face with a white fringe, females have a dark fringe around their face (Mittermeier et al. 2013).

***Plecturocebus toppini* (Thomas, 1914), Toppin's Titi Monkey, Mono tocón**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0864, –069.5102; elev. 258 m; 07.30.2017. P.S. Champagne obs., recorded during mammal surveys and opportunistically.

Identification. *Plecturocebus toppini* is a small to medium-sized primate. No data are currently available on the size or weight of this species (Thomas 1914; Mittermeier et al. 2013). *Plecturocebus toppini* looks similar to *Plecturocebus cupreus* () and *Plecturocebus aureipalatii* () and has similar overall grizzled brown fur (Thomas 1914; Mittermeier et al. 2013; Byrne et al. 2016). The tail of *P. toppini* is dark with a whitish-grey tip, distinguishable from *P. cupreus* and *P. aureipalatii*, which both have more white fur in their tails (Vermeer and Alvarado 2015; Byrne et al. 2016). *Plecturocebus toppini* has a blackish frontal band, reddish-brown hairs on its ears, and reddish hair on the terminal parts of its limbs and covering its knees (Thomas 1914).

Order Rodentia

Family Caviidae

***Hydrochoerus hydrochaeris* (Linnaeus, 1766), Capybara, Ronsoco**

Figure 11A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0684, –069.5147; elev. 230 m; 5.VI.2013; P.S. Champagne obs., recorded opportunistically along the Las Piedras and Huascar rivers.

Identification. *Hydrochoerus hydrochaeris* is the largest rodent in the world, with a head and body

length of 107–134 cm and a weight of 35–65 kg. It is unmistakable due to the rectangular shape of its head and its square jaw, short ears, and uniformly coloured body, which varies from reddish to greyish brown. It has partially webbed feet, with four toes on the front feet and three on the hind feet (Emmons and Feer 1997).

Family Cuniculidae

***Cuniculus paca* (Linnaeus, 1766), Lowland Paca, Picuro**

Figure 11B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.073, –069.5116; elev. 238 m; 9.VI.2019; C.J. Payne obs., recorded by terrestrial camera traps, during mammal surveys, and opportunistically.

Identification. *Cuniculus paca* is a robust, medium-sized to large nocturnal rodent with a head and body length of 61.0–77.5 cm, and a weight of 5–13 kg. Its body is covered by short, brown fur with longitudinal rows of white spots. The underparts, throat, and chest are white. Its head is large and the cheeks swollen, and there is a small tail (Emmons and Feer 1997). The short tail of *C. paca* distinguishes it from *Dinomys branickii* (Peters, 1873), which has a much longer tail.

Family Dasyproctidae

Figure 11. Rodentia of the Las Piedras River tributary. **A.** *Hydrochoerus hydrochaeris*. **B.** *Cuniculus paca*. **C.** *Dasyprocta variegata*. **D.** *Myoprocta pratti*. **E.** *Dinomys branickii*.



***Dactylomys dactylinus* (Desmarest, 1817), Amazon Bamboo Rat, Pacamama**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0694, –069.4938; elev. 239 m; 31.VII.2019; C.J. Payne obs., recorded opportunistically.

Identification. *Dactylomys dactylinus* is a small rodent with a head and body length of 280–330 mm and a weight of 600–700 g. Its head is grey to beige, with a dark stripe between the eye and ear. Its muzzle is square, and its ears are small. The upper part of its body is generally yellow-olive streaked with black, and the sides of its body are paler. Its underparts are white. Its rear legs and the base of its tail are russet-orange. It is stocky in build. (Emmons and Feer 1997).

***Dasyprocta variegata* (Goldman, 1913), Brown Agouti, Anuje**

Figure 11C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.085, –069.5289; elev. 254 m; 11.I.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Dasyprocta variegata* is a medium-sized rodent with a head and body length of 44.5–54.0 cm and a weight of 3.0–5.2 kg. Its upper body is orange-brown, with a mixture of yellow, orange, brown, and black hairs. Its head and feet are black or dark brown. Its underparts vary from brown, yellow, or orange, or may be pale (Emmons and Feer 1997). *Dasyprocta variegata* is distinguished from *Myoprocta pratti* (Pocock, 1913) by its larger size and shorter tail.

***Myoprocta pratti* (Pocock, 1913), Green Acouchi, Punchana**

Figure 11D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0689, –069.5102; elev. 240 m; 10.II.2018; P.S. Champagne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Myoprocta pratti* is a small rodent with a head and body length of 298–383 mm and a weight of 800–1,200 g. Its head is orange-red, and the areas around its eyes and chin are mostly hairless. Its upper body and legs are olive-green, with a mixture of black and yellow hairs. Its underparts are orange-red, and its throat, chest, and abdomen are white (Emmons and Feer 1997).

Family Dinomyidae

***Dinomys branickii* (Peters, 1873), Pacarana, Picuromama**

Figure 11E

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 239 m; 22.VIII.2019; C.J. Payne obs., recorded by a terrestrial camera trap and opportunistic sightings.

Identification. *Dinomys branickii* is a medium-sized to large nocturnal rodent with a head and body length of 47–51 cm and a weight of 13–15 kg. It has a large, bulky body and a very large head (Emmons and Feer 1997). Its ears are short and rounded, and it has short limbs and a thick tail. Its fur is greyish on the head and shoulders but finely dashed and dark brown on the rest of the dorsum, with two or more rows of white circular spots on each longitudinal half of the body, from the shoulder girdle to the base of the tail (White and Alberico 1992).

Family Erethizontidae

***Coendou bicolor* (Tschudi, 1844), Bicoloured-spined porcupine, Puerco espín**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0709, –069.542; elev. 263 m; 23.IX.2019; C.J. Payne obs., recorded opportunistically.

Identification. *Coendou bicolor* is a medium-sized nocturnal and arboreal rodent with a head and body length of 37–49 cm and a weight of 3.4–4.7 kg. Its upper parts are blackish with black or brown shoulders speckled with white or yellow. It has large, narrow spines that are bicoloured white and black or brown. Its tail is longer than its head and body. Its underparts are a pale grey-brown with white on the feet (Emmons and Feer 1997).

***Coendou ichillus* (Voss & da Silva, 2001), Dwarf Streaked Porcupine**

Figure 12A

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0683, –069.4995; elev. 240 m; 20.V.2015; H. O'Donnell obs., recorded opportunistically.

Identification. *Coendou ichillus* is a small-bodied arboreal, nocturnal rodent. It has a long, prehensile tail



Figure 12. Rodentia (continued) of the Las Piedras River tributary. **A.** *Coendou ichillus*. **B.** *Coendou longicaudatus longicaudatus*. **C.** *Sciurus ignitus*. **D.** *Sciurus spadiceus*.

that exceeds three-quarters the length of its head and body. The dorsal pelage consists of 30–40 mm long, bicoloured quills, which have a yellowish base and dark brown or black tips, and longer 80 mm long bristle quills with pale tips. There are a few dark wool hairs in the dorsal pelage that are not readily visible. The lack of fur is a distinguishing feature when identifying this species. The head features some tricoloured quills which are light-coloured at the base and with a dark band at the tip. Wool hairs and sparsely distributed, short, bicoloured spines are on the rump. Coarse, 15 mm long hair covers the ventral pelage alongside a few wool hairs. The tail features dense, short, quills which are bicoloured at the base, similar to on the rump. Most of the tail is covered with black bristles. The lateral surfaces of the tail feature tricoloured bristles which converge dorsally to form an indistinct whitish or yellowish stripe near the centre of the tail. The caudal bristles which are under the tail are considerably denser than elsewhere on the body. The tip of the tail is naked. The feet and hands are covered in black, coarse hairs (Voss and da Silva 2001; Voss et al. 2013; Voss 2011). The individual was photographed and identified using the description by Voss and da Silva (2001). The individual is undoubtedly a dwarf porcupine of the genus *Coendou* due to the body size, and it is reasonable to assume the species to be *C. ichillus*, as this is the only species of dwarf porcupine currently known to exist in Peru.

***Coendou longicaudatus longicaudatus* (Linnaeus, 1758), Brazilian Porcupine, Puerco espín**

Figure 12B

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0683, –069.4919; elev. 240 m; 28.VIII.2017; C. Rushford obs., recorded by an arboreal camera trap and opportunistically.

Identification. *Coendou longicaudatus longicaudatus* is a medium-sized nocturnal, arboreal rodent with a head and body length of 44–56 cm and a weight of 3.2–5.3 kg. It has short ears and large eyes. Its fur is composed of rigid, aculeiform, fine hair. The fur on its dorsum varies from black to yellowish brown and on the ventral surface from white to grey. Its tail is prehensile and bears spines in the proximal half and bristles in the distal half (Emmons and Feer 1997). Recent taxonomic revision of the *Coendou prehensilis* species complex proposed that it is comprised of three distinct species, with *C. prehensilis* occurring in the northern Atlantic Forest, *C. baturitensis* occurring in the eastern Amazon and the Caatinga, and *C. longicaudatus* occurring in the western Amazon and the Cerrado and Chaco. *Coendou longicaudatus* comprises two subspecies, with *C. l. boliviensis* occurring in the Cerrado and Chaco, and *C. l. longicaudatus* inhabiting the western Amazon, including Las Piedras (Menezes et al. 2021).

Family Leporidae

***Sylvilagus* Linnaeus, 1758 sp., Conejo, Amazon Rabbit, Conejo de monte**

Figure 12C

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 239m; 25 August 2019; C.J. Payne obs., recorded by a terrestrial camera trap and opportunistically.

Identification. The *Sylvilagus brasiliensis* species complex is a small forest rabbit. It has a head and body length of 268–395 mm and a weight of 450–1,200 g. It has relatively long ears, a predominantly brown body and a black tail that is darker on top and lighter near the bottom. Its upper parts are dark and generally black or tawny, and its underparts are lighter (Emmons and Feer 1997; Diersing and Wilson 2017). Recently, the taxonomy of the *Sylvilagus* genus has been under review. *Sylvilagus brasiliensis* was previously listed in the Las Piedras region (Emmons and Feer 1997). Recent research by Diersing and Wilson (2017) suggests it is possible that either *S. brasiliensis defilippi* or *S. andinus* may reside in the Amazon Basin. Diersing and Wilson (2017) highlighted the importance of collecting morphological and molecular samples across the Andes into the Amazon Basin to determine the range of *Sylvilagus andinus* in the lowland Amazon. Other researchers such as Rudeas et al. (2019) believe that there is a clear species distinction between *S. andinus* and *S. brasiliensis*. Although the distribution of these two species remains unknown, Ruedas et al. (2019) stated that *Sylvilagus andinus* is restricted to the Andes. Without further morphological and molecular samples, it is still not clear which species of *Sylvilagus* fall within the tributary of the Las Piedras River.

Family Sciuridae

***Microsciurus flaviventer* (Gray, 1867), Amazon Dwarf Squirrel, Ardilla enana**

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0689, –069.510; elev. 238 m; 2.X.2019; C.J. Payne obs., recorded using terrestrial camera traps.

Identification. *Microsciurus flaviventer* is a very small squirrel species with a head and body length of 120–160 mm and a weight of 80–132 g (Thorington et al. 2012; Jessen et al. 2016). It is smaller in size and has a narrower, less bushy tail than *S. ignitus* (Gray, 1867) and *S. spadiceus* (Olfers, 1818). The dorsal area is reddish-brown to olive-green, and its underside area is yellow, orange, or grey (Jessen et al. 2016). It has very short, pale ears and a thin, tapered tail, which is shorter than its body and banded with yellowish-orange hair (Eisenberg and Redford 1999; Emmons and Feer 1997; Jessen et al. 2016).

***Sciurus ignitus* (Gray, 1867), Bolivian Squirrel, Ardilla ceniza, Red-bellied Squirrel**

Figure 12D

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0673, –069.4947; elev. 240 m; 22.IX.2017; C. Rushford obs., recorded by a terrestrial camera trap and arboreal camera trap.

Identification. *Sciurus ignitus* is a small squirrel with a body length of 180–195 mm and a weight of 225–240 g. It is significantly smaller than *S. spadiceus* but larger than *M. flaviventer*, with a wider and bushier tail and longer ears. It can be orange-red in colour, with a white belly, back, and legs, or it can be grey with a white belly. In grey individuals, the upper parts are olive-brown, while the underparts, chin, throat, and chest are white with pale buff. The tail is narrow and the same colour as the back hairs but tipped yellowish. The ears extend above the crown of the head, and there is a small buff patch behind each ear. The eyes have a distinct pale ring (Emmons and Feer 1997; Merrick, Ketchum and Koprowski 2014). The distribution of *S. ignitus* in Madre de Dios overlaps with *Sciurus sanborni* (); however, it can be distinguished from *S. sanborni* by its smaller size (Thorington et al. 2012; Merrick et al. 2014).

***Sciurus spadiceus* (Olfers, 1818), Southern Amazon Red Squirrel, Ardilla roja**

Figure 12E

Records. PERU – **MADRE DE DIOS** • Tambopata, Las Piedras River; –12.0786, –069.5117; elev. 238 m; 2.VI.2019; C.J. Payne obs., recorded by terrestrial camera traps and opportunistically.

Identification. *Sciurus spadiceus* is a large squirrel species with a head and body length of 475–628 mm, tail length of 240–340 mm, and a weight of 600–650 g (Gwinn et al. 2012). It varies from deep-red to orange, with black hairs sometimes mixed in. However, this species also has a black colour morph (Gwinn et al. 2012). It has a long, very bushy tail, which is longer than its body; the tail is usually black at its base and orange near its tip. This species can be distinguished from *S. ignitus* and *M. flaviventer* by its much larger size (Emmons and Feer 1997, Gwinn et al. 2012).

DISCUSSION

Our species list demonstrates that the Las Piedras tributary is home to at least 60 mammal species. Species lists for the Las Piedras tributary have been previously published for amphibians, fish, and terrestrial

mammals (Von May 2009; Carvalho et al. 2012). For terrestrial mammals, Zwicker (2015) reported 23 species recorded during a camera-trap study that included 4,066 camera-trap nights. Herein, we document 25 terrestrial, 28 arboreal, four semi-arboreal, and three semi-aquatic mammal species. Sixteen of the recorded species have been assessed as Endangered (2) Vulnerable (9), or Near Threatened (5) by the International Union for Conservation of Nature Red List of Threatened Species (IUCN 2022). The observations contained within this paper indicate that the Las Piedras tributary holds a mammalian richness and diversity commensurate with the surrounding regional and national parks and protected reserves, such as the Amaraeri Communal Reserve, Cocha Cashu, Finca Las Piedras, Manú Biosphere Reserve, and the Los Amigos tributary (Solari et al. 2006; Tobler et al. 2008; Gregory et al. 2017; Whitworth et al. 2016). We will hereafter discuss species of particular interest, some published for the first time for the Las Piedras tributary.

Two species of canids are present in the study area. Both *Speothos venaticus* and *Atelocynus microtis* are considered rare and elusive (Leite-Pitman and Williams 2011; Oliveira et al. 2018). In the Madre de Dios department, these species have been observed in nationally and privately protected areas, including Manú National Park (e.g. Patterson et al. 2006), and the Los Amigos Conservation Concession (Tobler et al. 2008). *Atelocynus microtis* was previously reported from the Las Piedras area by Zwicker (2015) and O'Donnell (2021). Observations of both species were previously examined in Zwicker (2015), and the species were noted to occur in primary or intact forest cover at least 1 km from human disturbance. Congruently, our record of *S. venaticus* was observed at a remote locality, in a stream system inaccessible to boats and at least 1300 m from the Las Piedras River. It is likely that Zwicker's observations of *S. venaticus* are the only previous existing literature on the species occurrence in the area. The locality record of *S. venaticus* herein reported is likely the first for this species above the confluence of the Las Piedras and Huascar rivers.

To the best of our knowledge, this is the first published record of *Leopardus* cf. *tigrinus* in the lowland Peruvian Amazon. An individual female was recorded twice on 3 June 2019 on the same camera trap (−12.085, −069.5289) in terra firme rainforest within the TBX concession at an elevation of approximately 270 m above sea level.

Although the range of *L. tigrinus* includes the Amazon Basin, it appears to be an exceptionally rare species in this biome. Within the Amazon Basin, *L. tigrinus* has been reported in 36 different sites (Oliveira 2004). Of these reported sites, 64.7% were from Brazil and none were in the lowland Peruvian Amazon (Oliveira 2004). Oliveira et al. (2016) reported that *L. tigrinus* was not detected in all the thorough camera trap studies conducted in the Amazon Basin, which had a combined total trap days of 56,837.

In Peru, records of *L. tigrinus* are few. In a thorough analysis of records of carnivore species in Peru, Hurtado et al. (2016) found only 10 records of *L. tigrinus*, which consisted of four museum specimen records and six records from a literature review. These records were all in the Peruvian Yungas ecoregion (Hurtado et al. 2016). The only published contemporary record was in a high-elevation forest at Tabaconas Namballe National Sanctuary (Amanzo et al. 2003; Hurtado et al. 2016). Furthermore, we found three additional published records of *L. tigrinus* in Peru, but none of these records are from the lowland Peruvian Amazon. Pillco Huarcaya et al. (2020) conducted a camera trap survey in the Sira Communal Reserve and reported the presence of *L. tigrinus* at elevations between 1,200 m and 1,800 m. Piana and Luna (2016) detected the presence of *L. tigrinus* in a camera-trap survey in the high-altitude forest in the Wayqecha Cloud Forest Research Station, which is in the buffer zone of Manú National Park. Solari et al. (2006) reported a sighting of *L. tigrinus* in a grove of bamboo in the cloud forest of Manú National Park at an elevation of 1,460 m.

We provide the first report of *Galictis vittata* from the Las Piedras River. Two videos of *G. vittata* were recorded in floodplain forest on a camera trap located along a trail approximately 80 m from the Loboyoc stream and 200 m from the Las Piedras River, close to the confluence of the two tributaries. The videos were recorded at 1057 h and 1101 h, both on 8 June 2016. Individual identification was not possible, therefore, it is unknown if the two videos were of the same individual. Several observations of *G. vittata* were made during nocturnal stream surveys in 2013 within the waterfall stream of the TBX concession (PSC unpublished observations 2012, 2013). Few papers provide locality records for *G. vittata* in Madre de Dios. Surveys that have reported locality records, such as at the Cocha Cashu Biological Station in Manú National Park and the Los Amigos Conservation Concession, have noted the rarity of the species (Janson and Emmons 1990; Tobler et al. 2008).

Rushford and Glynn (2023) recorded *Glironia venusta* on the TBX concession along the Las Piedras River using arboreal camera traps in May 2017. Prior to these videos, the only record of *G. venusta* in southeastern Peru was from the Cocha Cashu Biological Station along the Madre de Dios River (Ardente et al. 2013; Solari et al. 2006). It is possible its small size and nocturnal behaviour have caused a rarity in sightings. Only 23 records of the species exist throughout the Amazon (Silveira et al. 2014; Arguero et al. 2017; Sant and Catzefflis 2018; Arévalo et al. 2021).

A single *Cyclopes thomasi* was found at TBX in September 2018. All published records of *Cyclopes* from the Madre de Dios region report *C. didactylus*; however, the species complex was recently revised (Salvador et al. 2011; Miranda et al. 2017). We determined that the individual found was *C. thomasi* based on the reported biogeography of the species distribution and with additional consultation with an expert on the taxa (Flavia Miranda personal communication 2021). The *C. didactylus* species complex is listed as Least Concern by the IUCN (2022), but the status of more recently proposed species, such as *C. thomasi*,

has not been assessed (Superina et al. 2010; Miranda et al. 2017). Locality records for *C. didactylus* have been reported from several protected areas including the Los Amigos River and Manú National Park (Solari et al. 2006; Salvador et al. 2011). This is likely the first published locality for a species of this complex on this tributary and the nearest locality that is north of the Madre de Dios River is from the Estación Biológica Los Amigos with a report of *C. didactylus* (Salvador et al. 2011).

We have identified 12 species of primates for the Las Piedras tributary. However, other species may be present in the region. We cannot with any certainty exclude the presence of a second species of saki monkey, *Pithecia rylandsi*, or *Lagothrix lagothricha*. *Pithecia rylandsi* has been recorded at various locations surrounding the Las Piedras tributary (Marsh 2014), and there are no clear geographical boundaries between those sites and our study area. According to the IUCN Red List of Threatened Species (2022), *L. lagothricha* also occurs along the Las Piedras River (Marsh et al. 2021). Although it is possible that *L. lagothricha* occurs along this river, we did not find it in our research area and perhaps it only occurs in areas farther north, such as the Madre de Dios Territorial Reserve and the Alto Purús National Reserve.

We present the first published records for *Cebuella pygmea*, *Saguinus imperator subgriseus*, and *Callimico goeldii* from the Las Piedras tributary. All three have rarely been reported in the Madre de Dios region and are challenging to record due to their small size. To our knowledge, the nearest localities of *C. pygmea* and *S. i. subgriseus* in Peru are in the Los Amigos River area and the Manú Biosphere Reserve (Salvador et al. 2011). Northeast of our study area in Bolivia and Brazil, *C. goeldii* has been documented in the tributaries of the Acre and Tahuamanu rivers (Buchanan-Smith et al. 2000).

Recently reported by O'donnell (2023), our record of *Coendou ichillus* is the first described from the Las Piedras tributary. Three photographs were taken of an individual with an iPhone 4s on 20 May 2015 at 1843 h in the Las Piedras Amazon Center campsite in the TBX concession. The porcupine was spotted and photographed in the open door of a tent porch. It thereafter climbed a tree in the campsite where it was no longer visible, and it was not observed returning to the ground. The campsite was in floodplain forest approximately 800 m from the Las Piedras River and approximately 50 m from the Loboyoc stream. *Coendou ichillus* was first described in 2001 (Voss and Silva 2001), with the first record from Peru confirmed in 2011 from a museum record (Voss 2011). The only regional records are from a 2019 camera-trap survey in Manú National Park which reported this species at four locations in 2015 and 2016 (Whitworth et al. 2019).

This paper contributes to our understanding of Amazonian biogeography by providing an assessment of the mammals present on the Las Piedras tributary. However, further sampling on smaller mammal species, such as those belonging to the orders Rodentia and Chiroptera, would provide a more comprehensive understanding of the mammalian diversity present. Ongoing and future research initiatives could employ previously used techniques such as sampling by mist net and ultrasonic recorder to study Chiroptera (Sampaio et al. 2003; Appel et al. 2022), and surveys using Sherman live traps and pitfall traps to study Rodentia (Mulungu et al. 2008; Barragán et al. 2010).

Furthermore, our findings highlight the possible importance of privately protected areas outside of national parks for mammal diversity and contain both new and unique information that can be used to inform future conservation efforts in the area. Unfortunately, the region is a hot spot for logging, gold mining, and agricultural activities (Sánchez-Cuervo et al. 2020). A study by Sánchez-Cuervo et al. (2020) showed that between 1993 and 2013 the Madre de Dios region lost 168,000 ha of primary forests. This same study found that land-use changes for agriculture increased by 470%, mining areas by 938%, and urban areas by 187%. Although the Inter-oceanic Highway is an important driver of deforestation, the numerous small unpaved roads that penetrate deep into primary forests are more likely to cause deforestation (Delgado 2008; Sánchez-Cuervo et al. 2020). The small-scale agricultural deforestation that is produced by expanding road networks is thought to exacerbate the isolation of the remaining forests, contributing to fauna and flora population declines and possibly affecting species interactions (Sánchez-Cuervo et al. 2020). The forests of the central Las Piedras corridor are afforded some level of protection by management practices of the private concessions herein reported. In Madre de Dios, a study focused on the privately protected Los Amigos Conservation Concession found that although management regimes did not have much of an effect at the mammalian community level, they did have significant impacts at the local level (Mena et al. 2021). Other research within the Amazon Basin has found that privately protected areas help protect mammal biodiversity, especially when combined with national parks (Soares et al. 2011). Although 22,430 ha of contiguous land in the central Las Piedras tributary is currently being conserved through concession management, it is difficult to determine how effective these management strategies are for preventing impacts on native mammal communities caused by hunting and habitat loss.

Our study, which identified 60 mammal species, reveals that the Las Piedras tributary boasts a level of mammalian richness and diversity on par with the neighboring regional and national parks as well as protected reserves. Nevertheless, conducting additional sampling specifically focused on smaller mammal species, particularly those falling under the orders Rodentia and Chiroptera, would provide a more comprehensive understanding of the full range of mammalian diversity within this area. While efforts are underway to conserve contiguous land in the central Las Piedras tributary through concession management, we emphasize that the protection of native species, including mammals, would greatly benefit from receiving resources and support equivalent to that allocated to national parks and other protected areas.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that no competing interests exist.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: CJP, PSC, PR. Data curation: CJP, PSC, HO, LRL, CR, PR, DR. Formal analysis: CJP, PSC, CR. Funding acquisition: PSC, PR. Investigation: CJP, PSC, HO, LRL, CR, PR, DR. Methodology: CJP, PSC, HO, LRL, CR, PR, DR. Resources: CJP, PSC, HO, LRL, CR. Visualization: CJP, PSC. Project administration: CJP, PSC. Software: PSC. Validation: CJP, PSC, HO, LRL, CR. Writing – original draft: CJP, PSC, HO, LRL, CR, PR, DR. Writing – review and editing: CJP, PSC, HO, LRL, CR.


Author ORCID iDs


Carter J. Payne  <https://orcid.org/0000-0003-1308-0903>

Patrick S. Champagne  <https://orcid.org/0000-0001-9125-8493>

Holly O'Donnell  <https://orcid.org/0000-0002-2559-8788>

Liselot R. Lange  <https://orcid.org/0000-0003-1382-3850>

Corrie Rushford  <https://orcid.org/0000-0001-8136-9149>

Paul Rosolie  <https://orcid.org/0000-0001-9645-942X>

Data availability

All data that support the findings of this study are available in the main text.

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